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AN EXPERIMENTAL PROGRAM IN ELEMENTARY MATHEMATICS FOR THE BLIND

by

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Retardation of achievement in arithmetic has long been a characteristic of blind children at all levels of education. Hayes (1941) and, more recently, Nolan and Ashcroft (1959) have found achievement of blind children to be approximately 16 percent below that of comparable groups of sighted children. The latter authors report test results which show that arithmetic retardation for blind groups averages from 7 to 11 school months. In the past a number of devices and teaching techniques have been developed and tested, but, to date, none of these have adequately solved this problem.

A possible solution to the problem may exist in an adaptation of an arithmetic curriculum developed by Dr. Andrew F. Schott (1957). This curriculum was developed for use by sighted children and approximately three-quarters of a million school children are currently being instructed by this method. Results reported by Schott (1960) indicate that sighted elementary groups instructed by this method exceed standard test norms for arithmetic achievement by an average of approximately one year. The purpose of this paper is to briefly describe this curriculum, give results of a pilot study of its usefulness for the blind, describe the subsequent adaptations made, and the plans for further evaluation of the adapted curriculum.

The Curriculum

The basic premise of the curriculum is stated by Schott (1957) as follows: ".... childrens' learning experiences in the arithmetic classroom must be structured

learning experiences which aid in the development of the abstractions, generalizations, and conceptualizations basic to an understanding of arithmetic." To accomplish this aim the curriculum is divided into five topics: counting, addition, multiplication, subtraction, and division. All of these topics are studied during each of the two semesters of the school year. This procedure is repeated for grades 1, 2, and 3. However, each time the five mathematical topics are repeated the level of complexity of each is increased. By the end of the third year or middle of the fourth year all pupils will have studied and completed (1) ordinal numbers, (2) addition, (3) multiplication and powers of 10, (4) subtraction, and (5) division and roots.

In addition to mathematics, the curriculum also emphasizes reading and vocabulary. The children learn to orally describe the operations of mathematics which enables individual children to lead the entire class through the solution of a problem involving any topic. In addition, children learn to write problems in complete mathematical and literal statements.

The structure of the curriculum allows for both group and individualized instruction. Each child can proceed at his own rate. A record keeping system identifies each child's point of achievement within the curriculum enabling teachers to start each child at the point of learning appropriate at the start of each new year.

A form of the abacus called a Numberaid is used as a primary teaching tool. Use of the Numberaid enables children to observe arithmetical operations in concrete terms and to express these through actual manipulation of the counters. This method takes arithmetic out of the abstract and expresses it in behavioral terms appropriate to the level of maturation of elementary level children. This tool is particularly important in the case of blind children since it allows numbers and arithmetical concepts to be expressed in a completely tactual manner. As children begin to attain mathematical proficiency, use of this tool diminishes and common mental mathematical operations are substituted.

Results of a Pilot Study

During the 1960-61 school year, the curriculum was used in 13 first and second grade classes of the following residential schools for the blind: Kentucky, Michigan, Missouri, Western Pennsylvania, and Virginia. Both Braille and large type readers were involved. Classes were included at a school only if the teacher had been able to attend a one or two-week teacher training session in the method. However, this training was for teachers of sighted children. Because little or no Braille or large type material was available, most instruction was given orally. However, the Numberaid, adapted so the counters would not slide freely, was used by all children.

Arithmetic achievement was tested using the Arithmetic Computation Test, Stanford Achievement Tests, Primary Battery, Form J. The test was reproduced in 18-point type for large type readers and standard times were used. For Braille readers the test was administered orally, again using standard time limits.

Subjects

Testing was carried out in 9 class groups at 3 of the schools. These groups included 31 first grade and 26 second grade Braille students and 11 first grade and 11 second grade large type students. Grade placement for first graders was 1.8 and that for second graders was 2.8.

Results

Medians and ranges of grade equivalent scores for each grade and reading medium are presented in Table 1. Both first grade groups achieved medians above the sighted norms for the test used, the Braille readers being 2 months accelerated and large type readers being 6 months accelerated. Both groups of second graders were 2 months retarded when compared with sighted norms for the test which amounts to about 7% retardation.

TABLE 1

MEDIAN GRADE EQUIVALENT SCORES AND SCORE RANGES FOR THE GROUPS

	Braille Readers		Large Type Readers	
	Grade 1	Grade 2	Grade 1	Grade 2
N	31	26	11	11
Median Grade Equivalent Scores	2.0	2.6	2.4	2.6
Range	1.0-2.9	1.9-3.4	1.0-2.8	1.9-3.5
Grade Placement	1.8	2.8	1.8	2.8

Results obtained in the pilot study indicate that blind children can approximate or exceed norms in arithmetic computation for sighted children when instructed under the experimental curriculum. This occurs in spite of the fact that teachers were inadequately trained and appropriate text materials were lacking.

All but one of the nine teachers expressed the opinion that they had been able to teach more mathematics than ever before. The teachers almost universally expressed the belief that greater achievement would have occurred if appropriate texts had been available and if Braille students had been able to write the problems in Braille.

On the basis of the findings of the pilot study, it was planned to undertake a formal three-year experimental evaluation of the adapted curriculum.

The Formal Three Year Experimental Evaluation

The project is sponsored by the American Printing House for the Blind under the direction of the senior author. Participating are children in the elementary grades of the Kentucky, Maryland, Michigan, Virginia and Western Pennsylvania schools. Dr. Schott has been retained as a consultant for the project and, with the assistance of the authors and the teachers involved, has adapted the curriculum and its materials for use with the blind.

Teacher Training

In August 1961, a special workshop for training teachers of the blind in the method was conducted by Dr. Schott with the assistance of the junior author. Of two weeks duration, the workshop was held at the Western Pennsylvania School under the sponsorship of the American Printing House. It was attended by teachers of all participating schools. Additional teacher training will be scheduled as deemed necessary.

Special Materials Used

The subject matter for the curriculum is contained in five Summary Books covering the topics: Counting, Addition, Multiplication, Subtraction and Division. These materials have been transcribed in both Braille and large type for use in the experimental program. For large type readers, both the numerical and literal work necessary to the program can be written in the summary books themselves or written on a translucent plastic overlay (the Plastislate) on each page, allowing for repeated use of the Summary Books. Braille students record numerical notations on the Calculaid, a device developed especially for this program. The Calculaid provides a Braille numerical recording space of five columns by ten rows with provisions for indicating the common arithmetical signs. Initial experiences indicate that children learn to use this device quite readily. For Braille readers, the literal written work necessary is completed on the Braillewriter or slate. All materials are being furnished the schools by the American Printing House.

Procedure of Evaluation

It is anticipated that 500-600 children in the elementary grades will be involved at some stage of the program. However, principal attention will be focused on the group of approximately 100 children who are presently enrolled in the first grade. Achievement of all children involved in the program will be tested at the end of each school year during 1962-64.

Since this program is experimental, the materials used in it will not be available for general use until the experiment is successfully completed. Correspondingly, special training in the method for teachers of the blind will be available only to teachers from participating schools. Highly significant findings early in the research program could possibly shorten the proposed three year evaluation.

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